ENGINEERING RESEARCH PRINCIPLES FOR ATTAINMENT OF VISION 10-2022

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Agenda

1. Engineering Research
2. Engineering Research Today
3. Where to find Local Engineering Problems
4. Action Plan for Vision10: 2022

Yes or No?

Industries in Nigeria are dead or almost dead?

Yes or No?

Nigerian industries do not normally fund research?

Yes or No?

Nigerian engineers are not usually practical. They are theoretical?

Yes or No?

Investors do not come to take up the inventions we have created?

Nigeria GDP 2006-2015

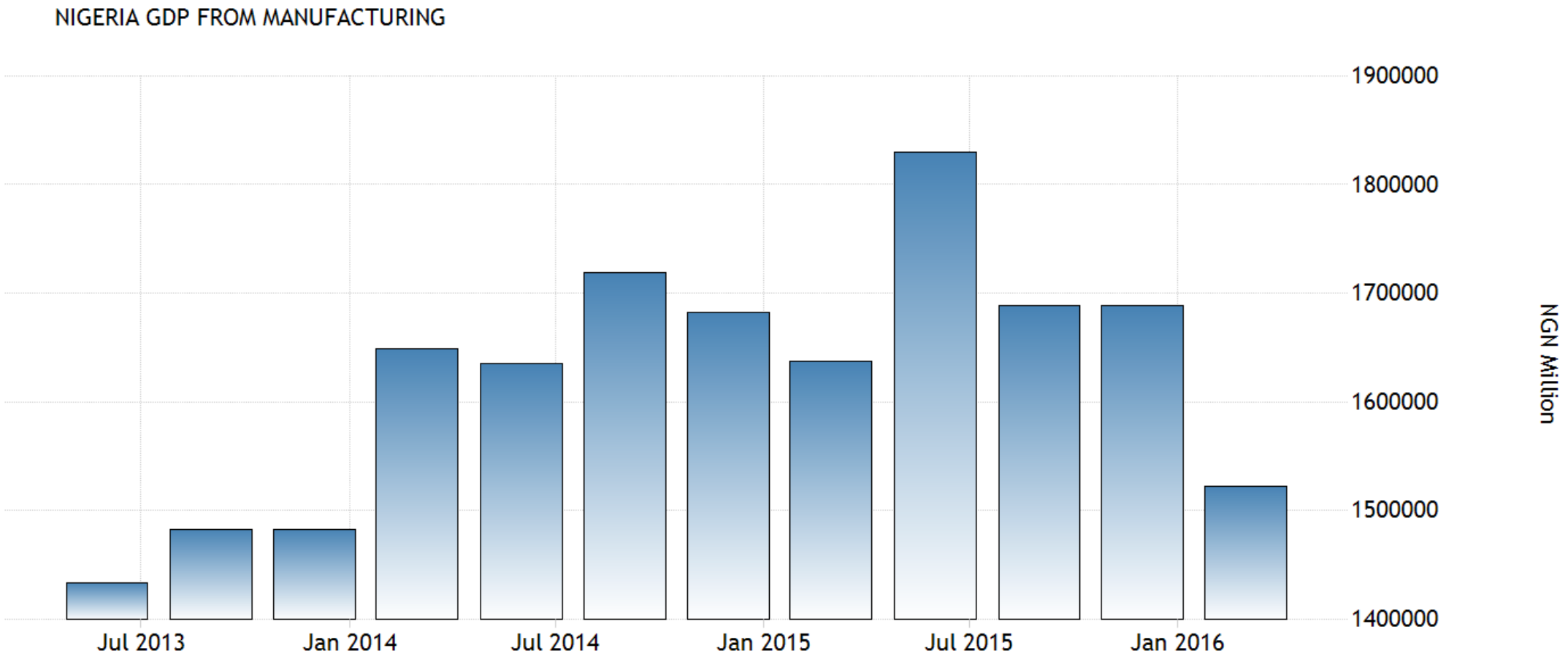
SOURCE: WWW.TRADINGECONOMICS.COM | WORLD BANK

Nigeria: Economy

The economy expanded by just 2.7% in 2015 well below the 6.4% in 2014. The GDP composition was:

- **Services 36%**
- **Agriculture 23%**
- **Oil and Gas 11%**
- **Manufacturing 9%**
- **Other 21%**

GDP from Manufacturing



SOURCE: WWW.TRADINGECONOMICS.COM | NATIONAL BUREAU OF STATISTICS, NIGERIA

Is this Problem only international in nature?

Can Covenant University be one of the Solution Providers?

YES!

REFOCUSING OUR ENGINEERING RESEARCH WILL GO A LONG WAY!

1

Engineering Research

What is Engineering?

Engineering is the profession in which a knowledge of the mathematical and natural sciences gained by study, experience and practice is applied with judgment to develop ways to utilise economically the materials and forces of nature for the benefit of mankind.

- **Accreditation Board for Engineering and Technology (ABET)**

Principle

A law or rule that has to be, or usually is to be followed, or can be desirably followed, or is an inevitable consequence of something, such as the laws observed in nature or the way that a system is constructed.

Engineering Research

- Basic scientific research is concerned with the discovery of new phenomena and their integration into coherent conceptual models of major physical, chemical or biological systems
- **But**, virtually all engineering research is driven by the anticipated value of an application

Engineering Research

- **Basic research in engineering is by definition concerned with the discovery and systematic conceptual structuring of knowledge.**

- **Generally, Engineering is concerned not only with knowledge of natural phenomena, but also with how knowledge can serve mankind's needs and wants.**

Engineering Research

Engineering and indeed Engineering research is also concerned with cost, user compatibility, producibility, safety, and adaptability. Various external operating conditions and environments must be taken into account in the design, development, operational support, and maintenance of the products and services created.

Innovation is our Reward!

ReCITe

Vision 20:2022: Industry Income

	UoM	2017	2018	2019	2020	2021
Create University Factories	Nos	3	5	5	10	20
Commercialise Patents	Nos	2	5	5	10	10
Partner Technology Owners for Certification	No	20	20	30	30	30
The Reward ($ Million)	$M	5	8	10	20	20

What is Innovation?

Innovation is the means by which the entrepreneur either creates new wealth - producing resources or endows existing resources with enhanced potential for creating wealth.

Peter Drucker

- **He sees the Discipline of Innovation as specific function of entrepreneurship**

What is Innovation?

Historically, innovation has been practiced within institutions. And it has been largely driven by companies, individual innovators, or specialized researchers and designers rather than by those who are ultimate users of the innovations.

What is Innovation?

- Incremental Innovation
- Radical innovation - different from incremental technological innovation of the past.
- Grassroots innovation- Appropriate Technologies .
- Others - Open innovation, Environmental innovation, Responsible innovation, etc

2

Engineering Research Today

Engineering Research Universities:

What I saw!

Cranfield University

- Exclusively postgraduate university
- Focus: Specialist themes - Aerospace, Defence and Security, Energy & Power, Environment & Agrifood, Manufacturing, Transport systems, and Water.
- World-class, large-scale facilities for research.
- Only university in the world to own and run an airport and to have airline status.
- 2016: A £35 million (N 17.5 Billion) Aerospace Integration Research Centre.

Cranfield University

- Train 4,500 PG students annually (5% of UK PhDs)
- 1,500 academic and support staff.
- Staff-to-student ratio - 5:1
- Industry Partners: Over 1,500
- 81% of research classed as world-leading or internationally excellent (Research Excellence Framework, 2014).
- Solving real-life problems.

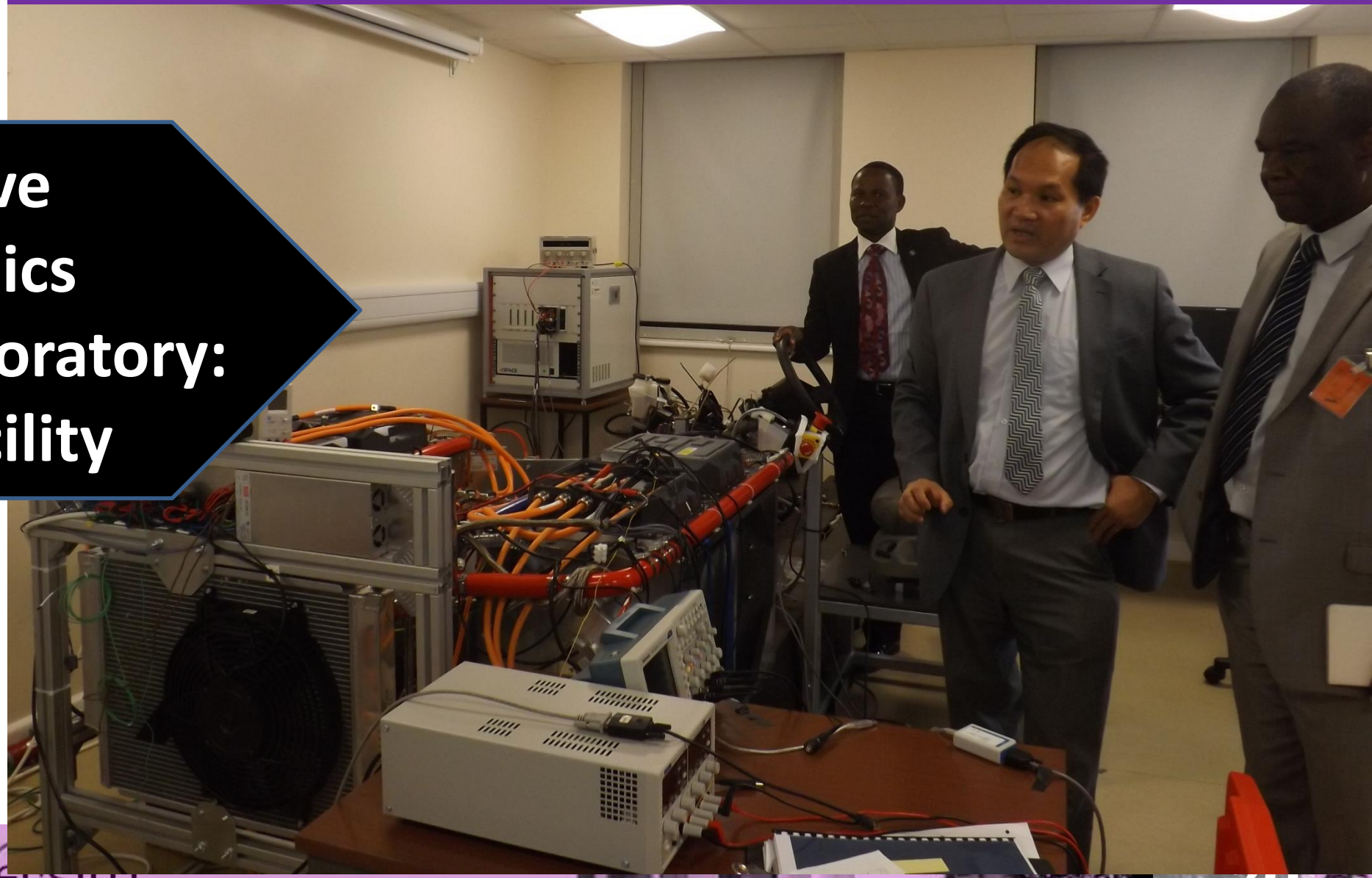
Cranfield University

Aerospace Laboratory: Life-size Aircraft Engine

Engineering Research Universities

Cranfield University

Automotive Mechatronics Engineering Laboratory: Life-size Facility



Cranfield University

Oil & Gas Engineering Laboratory: Life-size Facility

Lancaster University

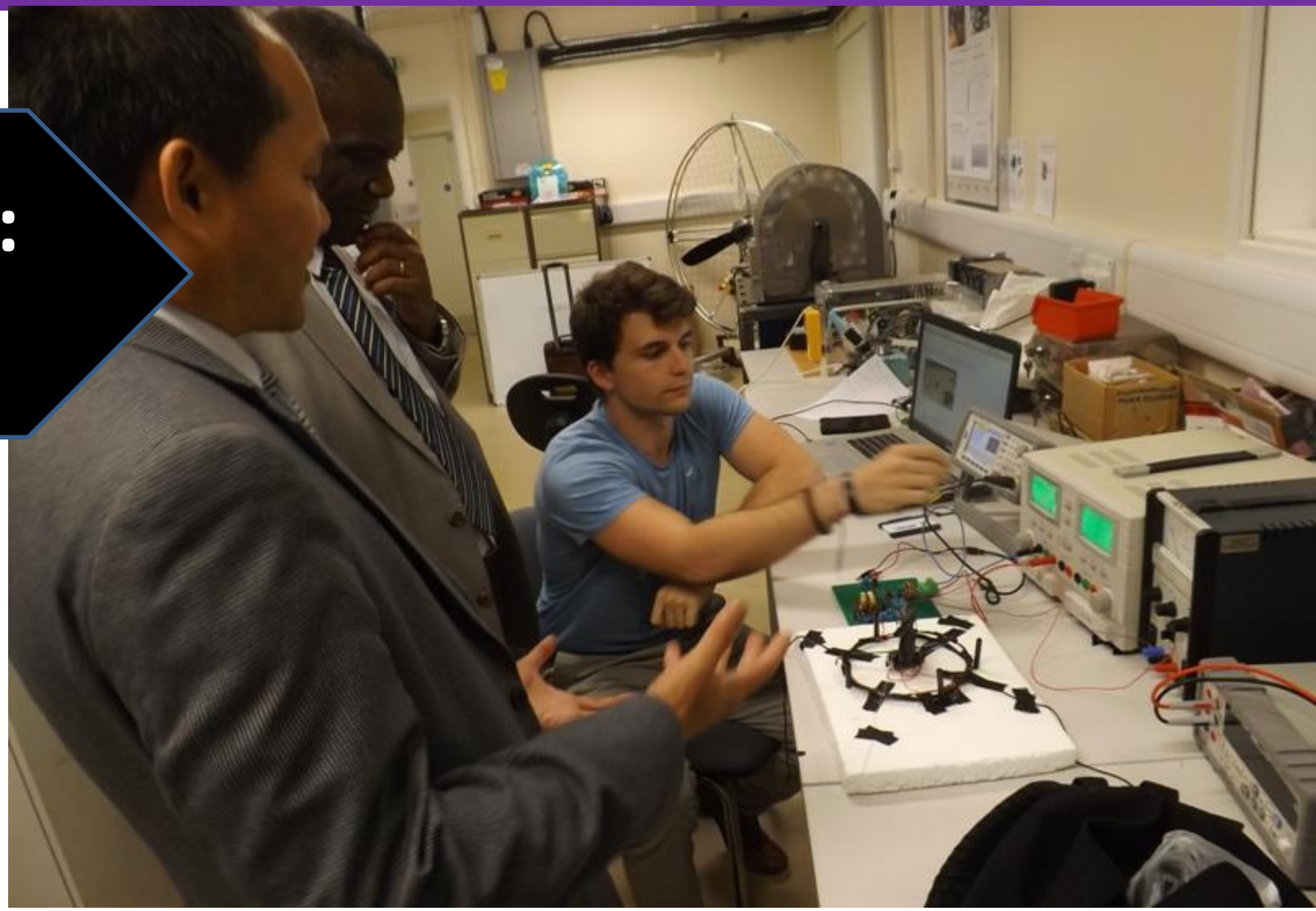
- 2nd Mechanical Engineering in the UK
- ONE Engineering Department (Multidisciplinary Research)
- State-of-the-art technological infrastructure
- Collaborate with other universities and companies, both locally and on a global scale
- Pioneering research relevant for industry

Lancaster University

Final Year Project: Multidisciplinary

Lancaster University

PG Student Project: Multidisciplinary



Lancaster University

Robotics Laboratory: Industry Scale Facility

What I learnt

- Engineering Research is exciting when it is multidisciplinary
- Engineering Research is even more exciting when the social sciences are involved!
- Pioneering research relevant for Nigerian industries of the future is possible.

What I learnt

- State-of-the-art **near industry size** technological infrastructure is important and **jointly owned**.
- Research Collaboration with other universities and companies, both locally and on a global scale is possible.

3

Where to find Local Engineering Problems for Research

Industry Changes

Recent significant changes in industry are raising the level of collaboration between private commercial sector and universities bringing about a cultural shift in higher education ……. shift affects research, pedagogy, funding and other areas of the academy

- Maria Klawe, Dean of Engineering, Princeton University

Industry Changes: US

- Downsizing of private research laboratories
- Example: AT&T, Bell, IBM, Xerox, etc (Exception: Microsoft)
- Smaller Start-up companies are dramatically increasing research activities

- Maria Klawe, Dean of Engineering, Princeton University

Industry Changes: Nigeria

- Capacity to fund university activities has reduces very significantly.
- Development of new products for profit only
- More effort on marketing and solving industry basic problems such as power and security

Impact on Research

- **Interdisciplinary, pure and applied research communities in industry disappeared.**

- **The most exciting problems lie at the interface between disciplines – not just between science and engineering, but at the interface with humanities and social sciences!**

- Maria Klawe, Dean of Engineering, Princeton University

Impact on Research

- **Research in industry laboratories have become focused on products – integrated and led by managers giving the direction.**

- **In contrast to the independent research done by university researcher driven by passion to discover more about a particular area**

- Maria Klawe, Dean of Engineering, Princeton University

Where to find Local Engineering Problems for Research?

- ❑ Organised Private Sector
- ❑ Informal Sector
- ❑ Covenant University Physical Planning Department (PPD)
- ❑ Centre for Systems & Information Services
- ❑ Engineering Students Project (>2,000)
- ❑ COREN & Nigerian Society of Engineers
- ❑ Alumni, etc

Organised Private Sector

- Manufacturers Association of Nigeria (MAN)
- Nigerian Association of Chambers of Commerce, Industry, Mines and Agriculture (NACCIMA)
- Nigeria Employers' Consultative Association (NECA)
- ETC

Manufacturers Association of Nigeria

✓Over 1000 members
✓75 Sectors

1. Food, Beverages & Tobacco (17 Sectors)
2. Chemicals & Pharmaceuticals [16]
3. Domestic & Industrial Plastic, Rubber & Foam [4]
4. Basic Metal, Iron & Steel And Fabricated Metal Products [10]
5. Pulp, Paper & Paper Products, Printing & Publishing [4]
6. Electrical & Electronics [5]
7. Textile, Wearing Apparel, Carpet, Leather/Leather Footwear [5]
8. Wood & Wood Products Including Furniture [2]
9. Non-metallic Mineral Products [4]
10. Motor Vehicle & Miscellaneous Assembly [8]

Yes or No?

Industries in Nigeria are dead or almost dead?

NO!

4

Action Plan for Vision10: 2022

Vision 10:2022: Industry Income

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University of Leeds (2015 Report)

ONE OF THE WORLD'S
TOP 100
UNIVERSITIES
(QS World Rankings 2015)

TOP10
FOR RESEARCH POWER IN THE UK

70%
OF PATENTS FROM THE CITY REGION'S UNIVERSITIES CAME FROM THE UNIVERSITY OF LEEDS

OVER 200
COLLABORATIVE RESEARCH PROJECTS
WORTH
£26.6M
DELIVERED IN 2013-14

CONTRACT RESEARCH PROJECTS WITH 160
BUSINESS PARTNERS WORTH
£48.7M

NATIONAL IMPACT

We've created over
100 spin-out companies
with market capitalisation of over
£500m

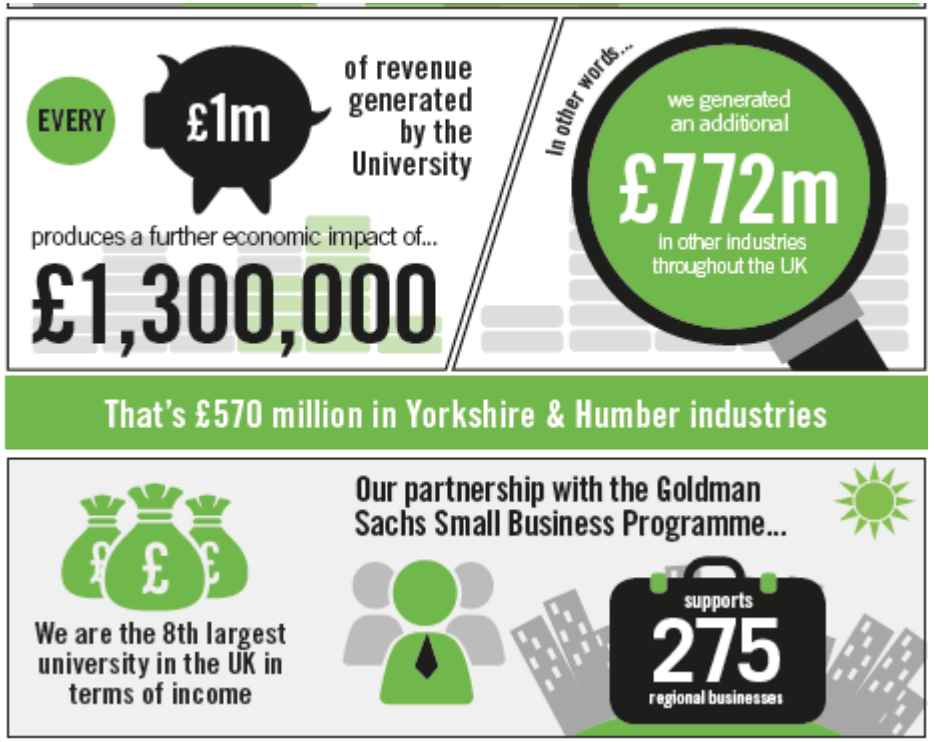
7 are listed on AIM
That's more than any other...
...university in the UK

Over 600 people are employed by these businesses

48 start-up companies were launched by students last year

37 student enterprises launched in our first dedicated business incubator

University of Leeds – Regional Impact



Afe Babalola University (ABUAD)

Directorate of Technological Development

- ❑ 121 Industrial Buildings
- ❑ 60 Small Scale industries
- ❑ 40 Medium Scale Industries
- ❑ 21 Large Scale Industries
- ❑ 20 Residential Junior Staff Quarters
- ❑ 20 Senior Staff Quarters
- ✓ Festo Authorised and Certified Training (FACT) Centre

N116 million for start-up!

Action Plan No 1: Pioneering Engineering Research Relevant for Nigerian Industries of the Future

- Specialise in the some areas such Sensor, Silicon & rural infrastructure, etc (including manufacturing)
- Research clusters to identify one each and 10 shortlisted for feasibility study
- Research Collaboration with other universities and companies, both locally and on a global scale

Action Plan No 2: Research Collaboration with Universities & Companies, both locally & global scale

- ❑ CBSS to do Sectoral Studies
- ❑ CBSS to do feasibility Studies of already completed Good Engineering Projects
- ❑ Research to align to local industry and thereby learn local problems
- ❑ Membership of MAN Sectoral groups
- ❑ Take-on PPD & CSIS Problems for Research projects
- ❑ Sabbatical/Internship in Industry for Faculty
- ❑ Research Collaboration with International Universities

Action Plan No 3: Engineering Research is even more exciting when the social sciences are involved!

- ❑ Interdisciplinary PG, MEng & PhD Research
- ❑ Industry based D.Eng & M.Eng

Action Plan No 4: State-of-the-art near industry size technological infrastructure is important and jointly owned

- ❑ Build Factories/ Research Factories
- ❑ Fabrication Base (Cranfield, ATBU Bauchi)
- ❑ Joint factory with industry

Vision 20:2022: Timeline

	2016	2017	2018	2019	2020	2021
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Commercialise Patents	**Nos**	**2**	**5**	**5**	**10**	**10**
Partner Technology Owners for Certification	**No**	**20**	**20**	**30**	**30**	**30**
Industry Income	**$M**	**5**	**8**	**10**	**20**	**20**

Conclusion

Can Covenant University be one of the Solution Providers?

YES!

Thank you!